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## GREAT LAKES AREAS OF CONCERN

# Review of the "Restrictions on Dredging" Beneficial Use Impairment

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Environment Canada  
4905 Dufferin St.  
Downsview, Ontario

REPORT



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### 1.0 INTRODUCTION

In 1972, the Canadian and U.S. governments signed the Great Lakes Water Quality Agreement in order to provide a co-ordinated approach to addressing environmental concerns in the Great Lakes. The original Agreement focused on phosphorus and associated problems regarding eutrophication. In 1978, the Agreement was revised to focus on toxic compounds and promoted an ecosystem approach to addressing water quality concerns. The 1978 Great Lakes Water Quality Agreement was amended by Protocol signed in November 1987. The Protocol contained a number of additional provisions, including Annex 2 and Annex 14, which committed both parties to undertake action to remedy areas of contaminated sediments within the Areas of Concern.

In 1985, based on recommendations from the Great Lakes states and the Province of Ontario, the Water Quality Board of the International Joint Commission (IJC) identified 42 (later 43) areas in the Great Lakes where contaminant concerns existed. These "Areas of Concern" (AOCs) formed the priority sites for environmental actions. The original listing of areas as AOCs was based on a list of 14 designated beneficial use impairments (BUIs). While the BUIs noted the major environmental impairments in each of the AOC, they also identified the issues that would need to be addressed for the area to be de-listed as an AOC. In many of these areas, contaminated sediments were identified as one of the causes of the use impairments and a number of the BUIs related directly to contaminated sediment issues:

- Degradation of benthos;
- Restrictions on fish and wildlife consumptions;
- Fish tumours or other deformities;
- Bird or animal deformities or reproductive problems; and
- Restrictions on dredging.

The implementation of source controls at many of the Areas of Concern has resulted in contaminated sediments now being the primary source of contaminants, and in some cases, the only impediments to de-listing of these areas.

In order for the RAP teams to progress towards delisting in the identified Great Lakes AOCs, the identified BUIs for each AOC need to be addressed. One of the identified BUIs was "restrictions on dredging". Where "restrictions on dredging" has been identified as a BUI, concerns have been identified with achieving the delisting target for this BUI. In nearly all cases where sediment concentrations of substances exceed available guidelines, there is potential for listing dredged material disposal as a BUI, irrespective of whether dredging activities would be undertaken at the AOC. As well, the BUI was based on economic and not environmental considerations that in many jurisdictions are no longer applicable. As a result, it is appropriate to review the basis of the dredging BUI.

This review is based on a general discussion of the applicability of the dredging BUI to assessing sediment contamination in Great Lakes AOCs, but is applied to the specific conditions in the Toronto and Region AOC and the Bay of Quinte AOC since "restrictions on dredging" has been identified as a BUI at each of these sites.



### 1.1 Background

In assessing potential sites in the Great Lakes Basin for designation as Areas of Concern, a list of 14 beneficial use impairments was developed (<http://www.great-lakes.net/envt/pollution/benefuse.html>). These formed the basis of identifying 26 sites in the U.S. Great Lakes and 17 sites in the Canadian Great Lakes as designated Areas of Concern. At the time, the restrictions on dredging BUI was included as one measure by which to assess sediment contaminants.

The IJC defined the BUI related to dredging on the basis of:

*“When contaminants in sediments do not exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.” (IJC 1991)*

As a result of this definition, the designation of restrictions on dredging as a BUI in an AOC depended entirely upon the chemical criteria used to assess sediments. However, most sediment criteria have been developed in a very conservative manner. Sediment guidelines as developed in Ontario and Canada are intended for generic application, and therefore must be sufficiently conservative that they are protective in all situations. These need to account for the variability of sediments (depending on sediment type, adsorptive capacity can vary substantially, which affects biological availability of sediment-bound contaminants) and differences in local geological conditions that can result in great variation in metals concentrations in sediment among different areas of the province and country.

Sediment surveys conducted in the Great Lakes have indicated that broad areas do not currently meet the sediment guidelines. This also means that meeting the requirements for designating this BUI as unimpaired would not be achievable in most AOCs, and also in many other, unimpaired regions of the Great Lakes. As a result, while other BUIs related to contaminated sediment may be deemed to be unimpaired, the narrow definition used in assessing the restrictions on dredging BUI can result in many AOC never achieving delisting, simply due to the requirement to meet very conservative, and in many cases, unattainable, sediment criteria.

Guidelines, such as the PSQGs or the CSQGs are based on the best information available at the time of their derivation. Sediment guidelines are typically based on the toxicological effects of contaminants in sediments, based on the adverse effects of specific contaminants on benthic organisms. The difficulties of obtaining meaningful toxicity data have been well documented in other sources (e.g., CCME 1999), and typically relate to the complex chemistry of sediments, and their interactions with different classes of contaminants. These relate mainly to the availability of contaminants from sediment, since biological availability ultimately determines toxicity. Few guidelines adequately account for the highly variable nature of sediments, and hence the high variability in contaminant bioavailability. This has been recognized in recent approaches to sediment assessment, that place less reliance on chemical concentrations in sediments, and more reliance on biological testing. Ultimately, this translates into chemical criteria being poor indicators of sediment quality.

The MOE, in developing the PSQGs, recognized the conservative nature of the guidelines, and in the implementation of the guidelines, has noted the requirement for biological testing to verify there are adverse effects due to contaminants that may exceed the guidelines. The implementation process clearly identifies the dangers in placing undue reliance on chemical criteria. While application of these criteria may serve as a handy reference for assessing sediment quality for dredging, they do not provide a realistic measure of the effects of dredge material disposal.



In the original listing of BUIs, “restrictions on dredging” was identified as a beneficial use impairment primarily for economic reasons. While sediments considered to be “clean” could be disposed of in open water, contaminated sediments would require containment in a confined disposal facility (CDF) or upland disposal, at often substantial cost, which was considered to be a negative economic consequence of sediment contamination at these sites.

In many cases, capital or maintenance dredging would not be considered as a foreseeable activity at the AOCs, which brings into question the applicability of this BUI for addressing contaminated sediment concerns. As well, open water disposal has over the years lost acceptance as a suitable solution for disposal of dredged material. Many jurisdictions have restricted the disposal of dredged sediments in the open waters of the Great Lakes, and the continued application of this BUI to Great Lakes AOCs is therefore questionable.

While “restrictions on dredging” can be considered as a surrogate for assessing contaminated sediments, progress in understanding sediment contaminant concerns, and in the development of risk-based approaches to assessing the potential impairments due to contaminants in sediments, has rendered this approach of questionable value. Better methods now exist for assessing the effects of contaminants in sediments, and understanding whether contaminated sediments present a concern. Accordingly, a revised approach is needed for this BUI.

### 1.2 Study Objectives

The objectives of the current study are two-fold:

- To conduct an overview of the BUI for “restrictions on dredging” and assess the applicability of the BUI to current conditions and regulatory approaches in Great Lakes AOCs; and
- To review conditions in the Toronto and Region AOC and the Bay of Quinte AOC with respect to navigational and maintenance dredging activities, and existing sediment conditions to assess whether this BUI should be considered impaired in this AOC.



## 2.0 RATIONALE FOR DREDGING BENEFICIAL USE IMPAIRMENT

### 2.1 Overview of the Restrictions on Dredging BUI

At the time that the BUIs were developed, open water disposal of dredged materials was considered a beneficial use, primarily due to economic reasons. Open water disposal was the most cost effective means of disposing of dredged material, and most dredging activity took place in commercial harbours, where capital or maintenance dredging was required to maintain navigational depths. Dredging in these areas typically involved the removal of substantial quantities of material, and hence could entail substantial disposal costs depending on the disposal method. Transport of dredged material via barge or scow to deeper open water areas of the lake was judged to be the most economical means of disposing of the dredged sediments. At the selected disposal site, the sediments would be released to drift through the water column, ultimately settling on the bottom. It was known at the time that open water disposal could affect aquatic communities by smothering, and could also introduce sediment types that were different from those occurring at the disposal site, thereby affecting local habitat type and quality, irrespective of whether the sediments were contaminated. Disposal of contaminated sediments also served to disperse contaminants in broader areas of the lake, and could also introduce contaminants into previously uncontaminated sites.

Since capital or maintenance dredging projects typically occurred in urban areas where working harbours served a range of industries, the sediments were often contaminated with a range of metals and organic compounds. Where contaminant concentrations exceeded local guidelines or regulatory limits, dredged material could not be disposed of in open waters, and materials would need to be placed in either confined disposal facilities or upland sites (typically landfills). The restriction on open water disposal thus could pose a substantial financial cost to dredging projects. It is worth noting that contaminants in sediments did not restrict the dredging activity, which typically was undertaken despite the additional disposal costs, since maintaining the functioning of the harbour was considered a priority.

Therefore, “restrictions on dredging” is a misnomer, since dredging activities would not be restricted in these areas due to contamination in sediment. Rather, the presence of contaminants restricted the option for dredged material disposal in open water to those sediments that met the sediment guidelines of the day. Dredging operations were not be curtailed in any of the AOCs where this was identified as a BUI, and in fact capital, maintenance and environmental dredging has been undertaken at a number of AOCs, the latter as part of remedial activities in support of delisting. Instead, dredged materials that did not meet guidelines would need to be disposed of at upland sites or in confined disposal facilities that would impose an additional cost on proponents, which were often state, provincial or federal agencies responsible for maintenance of shipping channels and harbour facilities. Open water disposal of sediment was considered an economically beneficial use, and it has always been recognized that this was not a benign activity and that there were environmental impacts associated with open water disposal. Since then, a number of states (Wisconsin, Michigan, Ohio) have severely restricted open water disposal on environmental grounds (<http://www.glc.org/dredging/case/documents/OpenWaterFinal.pdf>). Ontario permits open water disposal, provided that the conditions in MOE (2008) are met, but encourages proponents to find other beneficial uses for the material (the MOE typically requires additional environmental studies to demonstrate that open water disposal will not adversely affect the aquatic environment even where sediment concentrations of contaminants may not be a concern).



## RESTRICTIONS ON DREDGING BUI

Suitability of dredged material for open water disposal was assessed on the basis of the chemical composition of the material. The sediment to be dredged was compared to the existing sediment quality guidelines (in Ontario, the Open Water Disposal Guidelines developed in 1976 were used (Persaud and Wilkins 1976), while in the U.S. typically the U.S. EPA Region V sediment guidelines were used), and where the parameters measured were below the guidelines the sediment was considered suitable for open water disposal, irrespective of sediment type. In many cases where sediment originated from harbours, the sediment consisted mainly of fine materials that during disposal were subject to dispersion, and also increased suspended sediment concentrations locally.

In 1992, the Royal Commission on the Toronto Waterfront recommended a moratorium on all new lake filling activity until new guidelines on lake filling could be developed and implemented by the Province. This moratorium also resulted in reconsideration of open water disposal practices, and the moratorium was unofficially expanded to include open water disposal of dredged materials.

In 1993, with the development of the Provincial Sediment Quality Guidelines (PSQGs), Ontario developed an implementation procedure to assess sediment suitability for open water disposal (Persaud *et al.* 1993). In 1993 the Province also released the newly developed Lakefill Guidelines (Hayton *et al.* 1993). Since then, most new dredging projects have required that dredged sediments be tested prior to removal, and suitability for open water disposal assessed against the procedure included in the PSQG guidance (Persaud *et al.* 1993). Since 1993 disposal of sediments from most new dredging projects has been either in confined disposal facilities (CDFs), or at upland (landfill) sites due to either contaminant levels or physical unsuitability of the dredged material relative to potential disposal sites.

In 1998, the MOE and Environment Canada conducted a review of the dredging BUI with respect to the Nipigon Bay, Jackfish Bay, Spanish Harbour, Severn Sound, Niagara River and Bay of Quinte AOCs. The review noted that there was no identified need for navigational dredging in the areas where contaminants in sediments exceeded the MOE PSQG Lowest Effect Level (LEL) and that routine upland disposal for small scale dredging operations did not constitute an impairment. The review further noted that the environmental significance of contaminants in sediments was addressed through other BUIs, notably degradation of benthos, that directly assessed the effects of contaminants in sediments on sediment-dwelling biota, restrictions on fish and wildlife consumption that addressed bioavailability of contaminants from sediments, and the occurrence of fish tumours and reproductive effects on birds and mammals through exposure to contaminants associated with sediments.

Restrictions on dredging had historically been used as a BUI as a surrogate means of assessing sediment contamination. With the development of the 1993 PSQGs, an effects-based approach to assessing sediment contamination became available that was further defined in an assessment protocol in 1996 (Jaagumagi and Persaud 1996). This was further refined through the 2007 COA process (EC & MOE 2007).

The PSQG and COA approaches focused on the resultant biological effects as a measure of sediment impairment, recognizing that guidelines are developed in a conservative manner, and that generic guidelines are not necessarily indicative of site-specific conditions. The development of these guidelines has essentially rendered the restrictions on dredging BUI as a measure of primarily an economic effect, rather than an environmental impairment. The COA process notes that final reliance on determining whether sediments are impaired rests on both laboratory effects studies and field-based studies.

As a result, this BUI appears to be no longer justified in the case of most AOCs, since better means of assessing the effects of contaminants in sediments are now available. As well, it is arguable that an activity that by its very



nature can adversely affect aquatic habitats through physical disturbance and alteration should not be considered as a beneficial use.

### 2.2 Summary

A number of factors point to the need to reconsider the use of the restrictions on dredging BUI as an applicable and useful measure of sediment contamination:

- Open water disposal was not an environmentally benign activity. The use of restrictions on dredging as a BUI highlights the current paradox: restrictions on dredging were meant to mitigate the environmental effects of open water disposal due to contaminants in sediments, but no consideration was given to the adverse environmental effects on habitat that resulted from open water disposal of dredged sediments. Considering open water disposal as a beneficial use seems to be contrary to the whole spirit of the AOC process, which is focused on protecting and restoring the environment in these degraded areas.
- Primarily for these reasons, many jurisdictions have actively encouraged alternative means of disposal, or have severely limited the use of open water disposal. In many jurisdictions, there is a trend toward beneficial re-use of materials that recognizes dredged material can be a resource. A variety of applications are available depending on the chemical characterization of the material. Clean sands, for example, can be used for construction purposes or beach nourishment, thereby reducing the adverse effects of disposing of this material in open water.
- The reality that contaminants in sediment have not restricted dredging activities where it is required for navigational purposes, but have simply necessitated alternate means of disposal. The use of upland disposal sites or CDFs to contain contaminated material has had the dual benefit of reducing exposure of aquatic life to contaminants in sediments, and also reducing the habitat effects associated with open water disposal.
- The conservative nature of numerical guidelines that form the basis of the BUI, which will preclude many areas from attaining delisting, even though the adverse environmental and biological effects of contaminants in sediments may have been addressed. Designation of an activity as a BUI that, as a result of procedural requirements, cannot be reasonably achieved is counterproductive to the RAP process.
- The availability of alternative means of assessing the effects of contaminants in sediments that consider the biological effects on those organisms that are most directly exposed to contaminants in sediment. The biologically-based assessments that consider benthic community health, the direct assessment of the effects of contaminants through sediment toxicity tests, and the use of ecological risk assessments to assess potential effects of contaminants on higher trophic levels all provide more effective and robust means of assessing sediment contamination than restrictions on dredging, which rely solely upon very conservative numerical criteria.

All of these factors point to a need to consider the restrictions on dredging BUI to have low relevancy to assessing sediment contaminants in Great Lakes AOCs and, with respect to potential habitat effects, to be contrary to the aims of the RAP process. Recognizing that it will be difficult to have this BUI rescinded, the most effective approach for dealing with this BUI would be to generally consider restrictions on dredging as “unimpaired” in the AOCs.



### 2.3 Dredging Activity in the Toronto and Region AOC

Dredging in the Toronto and Region AOC is currently undertaken in the Keating Channel, with little dredging activity elsewhere. Approximately 40,000 m<sup>3</sup> is dredged on a yearly basis, with disposal of the dredged material in the Toronto CDF, as stipulated in the Environmental Assessment (EA) (Acres 1983). Three separate cells were set aside in the CDF to contain dredged material. To date, Cell 1 in the CDF has been filled and has been converted into a wetland habitat, thereby enhancing local habitat diversity through restoration of coastal wetlands.

Future plans for dredging in the Keating Channel include separation of clean material, with re-use of clean material as fill and disposal of the contaminated residues in the CDF. This approach will reduce the amount of material disposed of in the CDF and thereby extend the life of the facility. Dredging of the slips along the waterfront is only undertaken occasionally, with dredging of the slips last undertaken approximately 15 years ago. As the waterfront is re-developed, many of the existing slips will no longer be used for shipping, and will be transformed into aquatic habitat. Dredging is also occasionally undertaken around Ashbridges Bay and in the Eastern and Western Gaps to remove sand that has drifted around the entrance to the bay or in the channels. As a result, the material removed is generally clean sand and is re-used by the Toronto and Region Conservation Authority (TRCA), mainly for beach nourishment in areas along the eastern waterfront in areas of active shoreline erosion. As a result, open-water disposal of sediments is not currently undertaken in the Toronto and Region AOC.

Recent sediment assessments in the deeper basins of Lake Ontario (Marvin *et al.* 2002, 2004) show that contaminants in sediments exceed the sediment guidelines in large areas of the lake and that exceedances are not restricted to the AOCs. The results show that contaminants have been broadly dispersed in the lakes from a number of sources, including but not limited to AOCs. The occurrence of contaminant concentrations in sediments above the numerical guidelines is a broadly occurring issue that will need to be addressed through other avenues, such as the Lakewide Management Plans (LaMPs) rather than through BUIs that are applicable only to AOCs.

It is also questionable whether contaminant levels in sediments that exceed the LELs result in effects on biological receptors. As a result, the “restriction on dredging” BUI is now of limited applicability. Contaminants in sediments will not actually restrict dredging activities, and in area of known sediment contamination would only result in development of alternative to open water disposal, that would entail additional costs. Mitigation measures would ensure that any environmental effects of dredging could be contained. More suitable measures for assessing the effects of contaminants in sediments are now available with biologically based assessment protocols that specifically address the availability of contaminants in sediments to biota.

Within the Toronto and Region AOC, dredging activities are limited, and currently the only regular dredging activity is undertaken in the Keating Channel to maintain water depth. Since disposal of dredged material into the CDF is a requirement of the EA, there is no option for open water disposal of this material. There are no foreseeable dredging activities to be undertaken in the remainder of the AOC. As such, dredging activities in the Toronto and Region AOC can be considered as not impaired.

### 2.4 Dredging Activity in the Bay of Quinte AOC

Dredging activity in the Bay of Quinte is typically restricted to private landowners seeking to deepen waters around their properties to facilitate pleasure boat access (Pers. Comm. - Brad McNevin, Quinte Conservation).



## RESTRICTIONS ON DREDGING BUI

The applications for dredging are generally limited to a small number of projects (up to 15 per year), and represent small volumes of material that are removed for recreational boating purposes.

Localized dredging for the installation of geothermal heating loops also requires dredging, since the loops are typically installed at least 1.6m (5 feet) below the bottom of the lake. Installation requires trenching, with the dredged material used to backfill the trench.

Review of these projects is initiated through an application to the Conservation Authority. The Conservation Authority reviews the application with respect to potential impacts on fish habitat, flood plain management and shoreline alteration regulations. The Conservation Authority forwards the application to the MNR for review as well. Approval for the project is typically provided through a Letter of Advice that describes specific mitigation measures that the proponent is required to meet. Dredging projects for recreational boating needs typically require the upland disposal of any dredged material. As noted above, geothermal heat loop installation required backfilling with the excavated sediment.

In some cases the Conservation Authority also undertakes dredging for construction of fish habitat. The Conservation Authority reports that no navigational dredging has been requested or undertaken within the Quinte Conservation jurisdiction.

Recent sediment data (Biberhofer and Dunnett 2006) show that aside from localized areas in the Belleville and Trenton waterfronts, sediment contaminants in the Bay are low, and typically are due to metals and some organic compounds that are present at concentrations slightly above the MOE PSQG LELs. Biological assessment studies (Milani and Grapentine 2006), note the absence of biological impacts in most areas of the Bay, with localized impacts reported only in isolated pockets in the urban industrial areas of Belleville and Trenton.

Capital or maintenance dredging is not a typical activity in the Bay, since there are no harbours within the Bay that are suitable for ship traffic. As a result most dredging is performed as part of small localized projects to provide pleasure boat access to private properties along the shore and therefore, dredging is not an activity that is expected to result in release of contaminants from sediments. As well, sediment contaminant concentrations are low in the Bay, and would not restrict open-water disposal of sediments from the small localized projects that are typically approved. Rather, effects of disposal of dredged material on aquatic habitats is the main concern resulting in the requirement for upland disposal of dredged materials. The same rationale would apply to requirements for any proposed capital or maintenance dredging projects. As a result, "restrictions on dredging" does not appear to be a BUI that is relevant to the current conditions in the Bay of Quinte.

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Rein Jaagumagi  
Senior Environmental Specialist

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[solutions@golder.com](mailto:solutions@golder.com)  
[www.golder.com](http://www.golder.com)

**Golder Associates Ltd.**  
**6700 Century Avenue**  
**Mail: 2390 Argentia Road, Mississauga, Ontario, L5N 5Z7**  
**Canada**  
**T: +1 (905) 567 4444**

